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Stecewycz

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(54) **COMPACT BATTERY CLAMP AND BOOSTER CABLE**

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H01R 4/48	(2006.01)
H01R 4/50	(2006.01)

(52) **U.S. Cl.**

CPC ***H01R 11/11*** (2013.01); ***H01R 4/489*** (2013.01); ***H01R 4/5008*** (2013.01); *Y10T 29/49174* (2015.01)

(58) **Field of Classification Search**

CPC H01R 11/24; H01R 11/281; H01R 11/288; H01R 11/289; H01R 11/11; H01R 43/00; H01R 4/489; H01R 4/5008; G01R 31/3696; H02J 7/0054; Y10T 29/49174

USPC 174/146; 439/504

See application file for complete search history.

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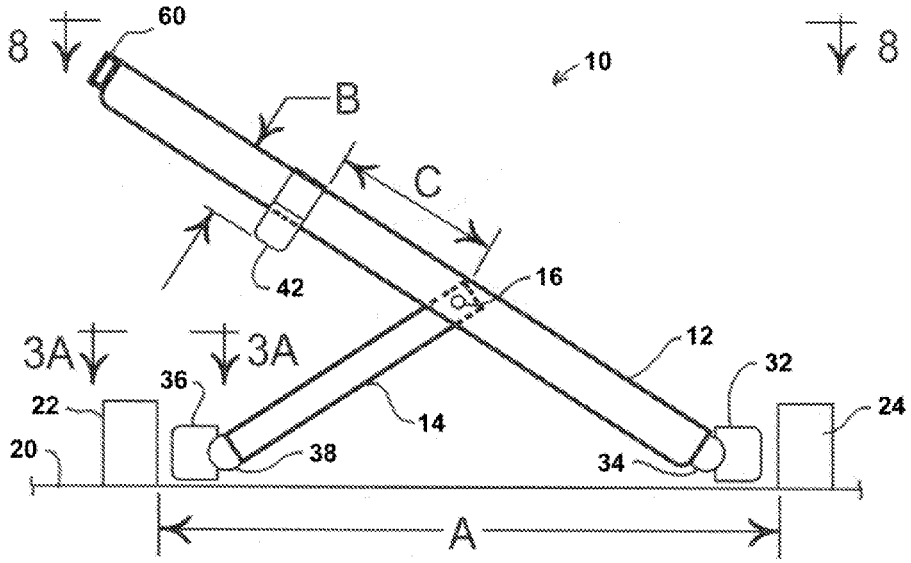
(57) **ABSTRACT**

Disclosed is a compact battery clamp suitable for attachment to a high-amperage, two-conductor, insulated electrical cable, the compact battery clamp comprising: a clamp handle having a first clamp handle end and a second clamp handle end; a contact arm having a first contact arm end and a second contact arm end; a pivot pin passing through the clamp handle and through the first contact arm end so as to hingedly connect the contact arm to the clamp handle; a first terminal contact pad rotatably attached to the first clamp handle end; a second terminal contact pad rotatably attached to the second contact arm end; and an electrical socket attached to the second clamp handle end, the electrical socket configured for electrically coupling with an end of the insulated electrical cable.

17 Claims, 8 Drawing Sheets



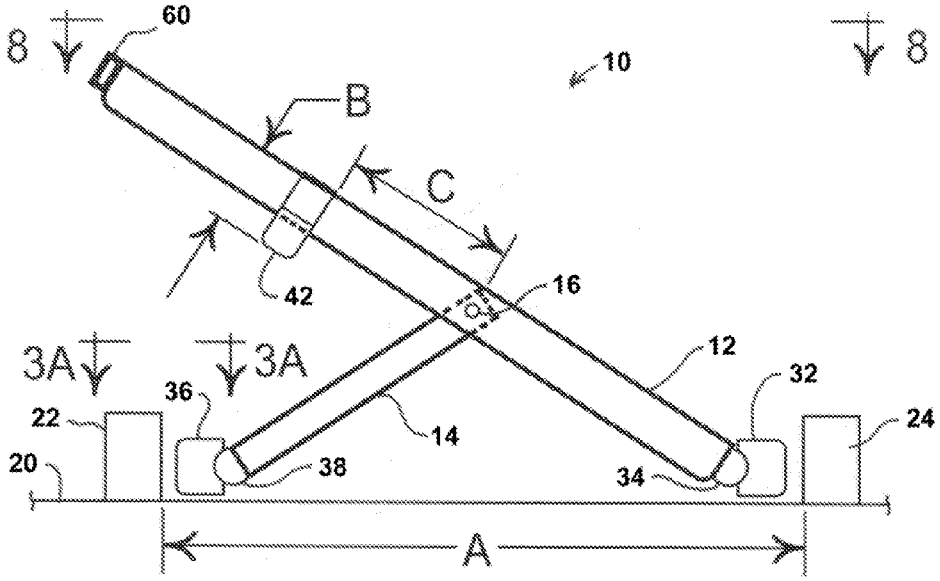

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Fig. 1

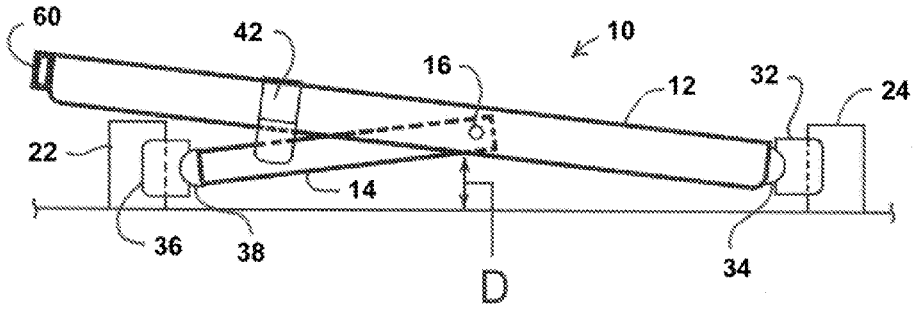
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Fig. 2

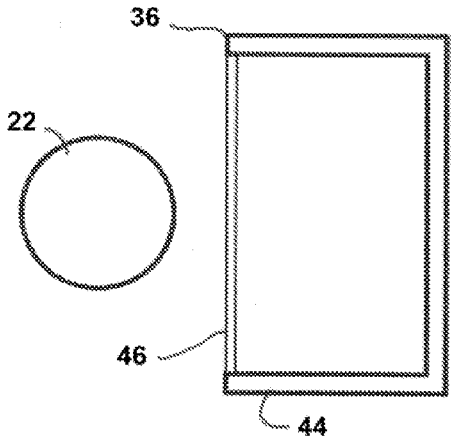

Fig. 3A

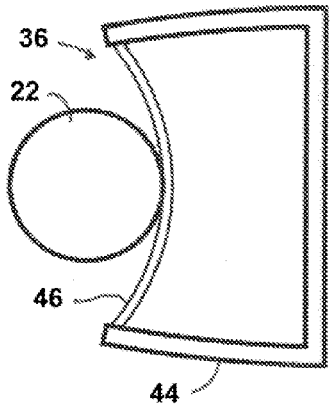

Fig. 3B

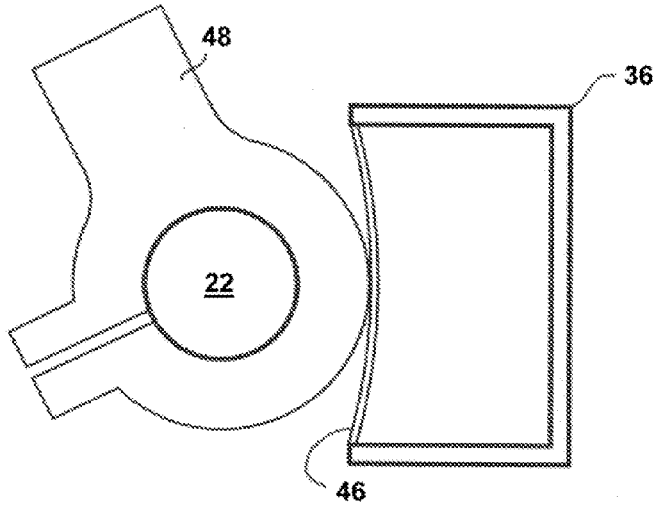

Fig. 4

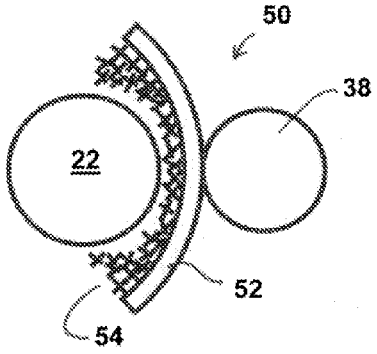

Fig. 5

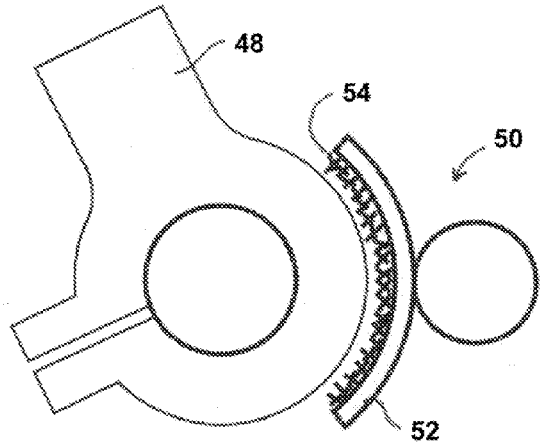

Fig. 6

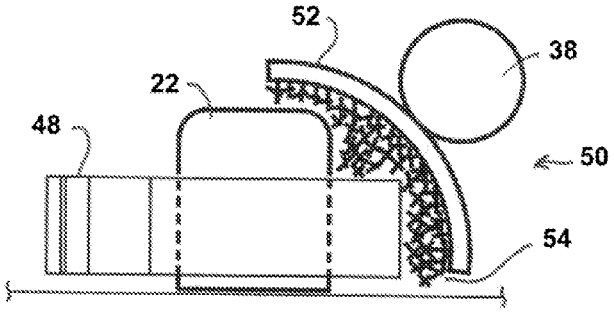

Fig. 7

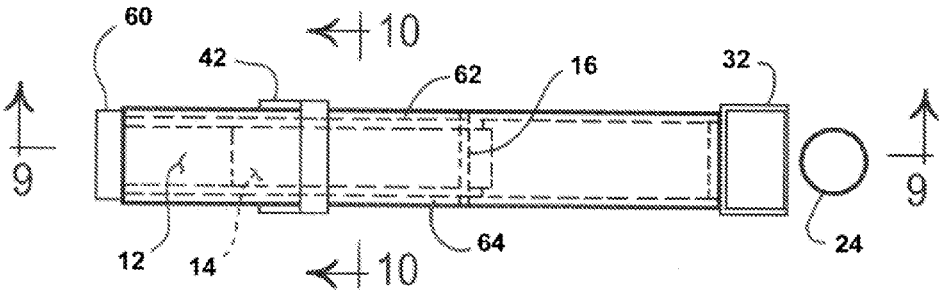
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Fig. 8

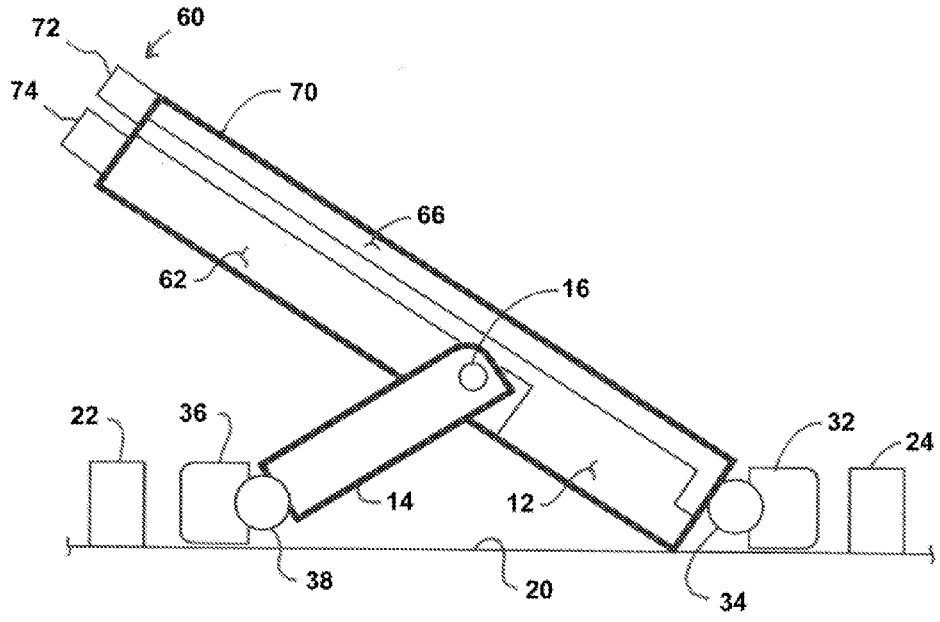
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Fig. 9

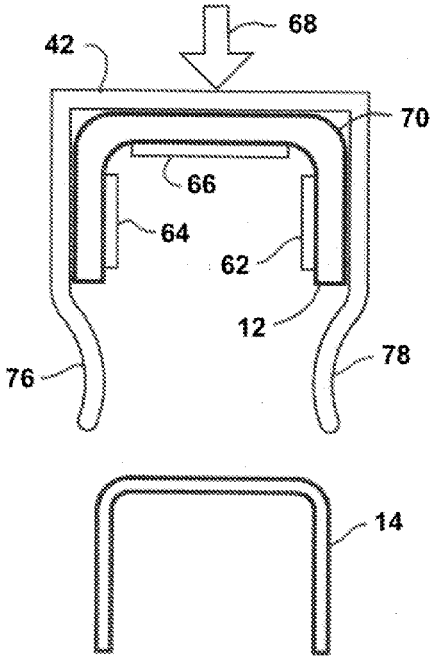

Fig. 10

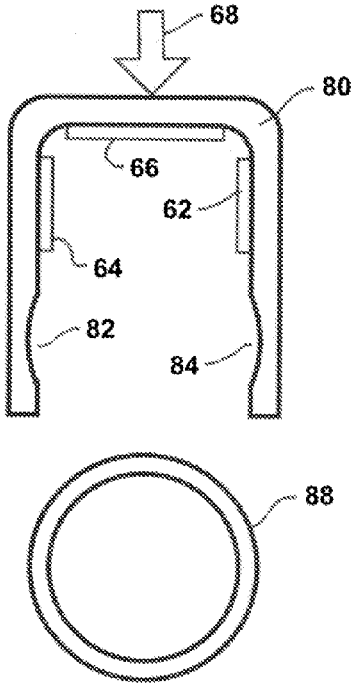

Fig. 11

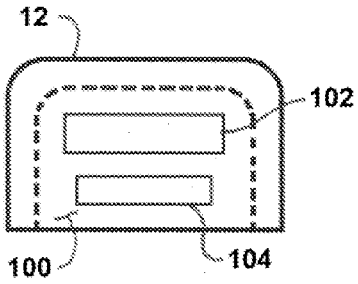

Fig. 12

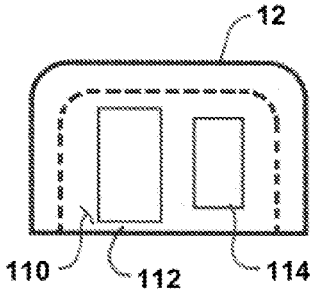

Fig. 13

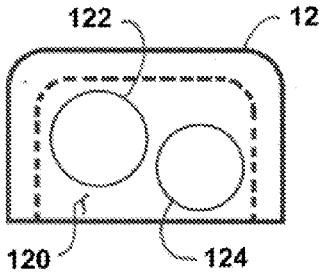

Fig. 14

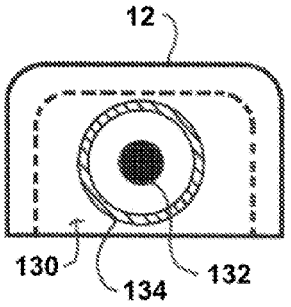

Fig. 15

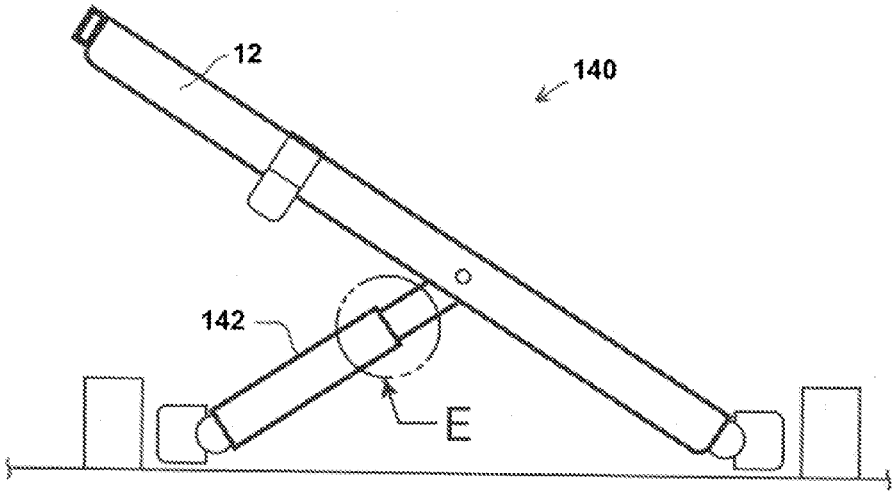

Fig. 16

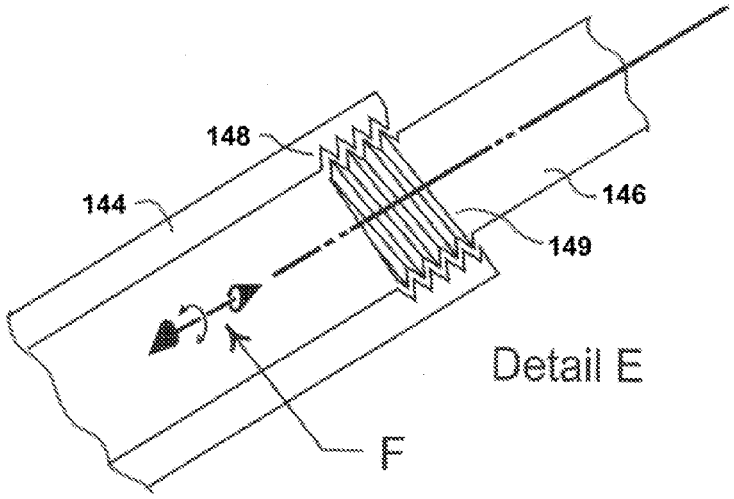

Fig. 17

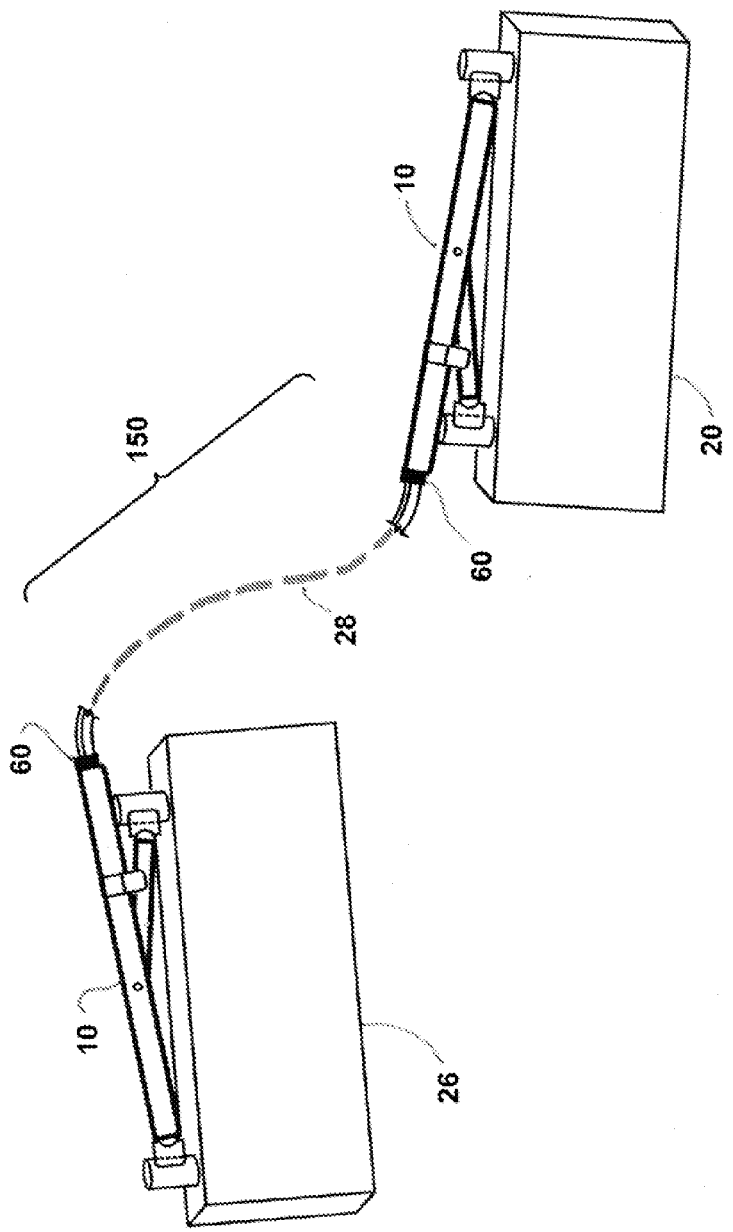

Fig. 18

COMPACT BATTERY CLAMP AND BOOSTER CABLE

CROSS REFERENCE TO RELATED APPLICATION

The present application is related to Provisional Patent Application entitled "Compact Battery Clamp," filed 20 Nov. 2012 and assigned filing No. 61/728,738, incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

This invention relates to a device for providing a method of electrically connecting to the terminals of a battery and, in particular, a device for enabling quick and convenient electrical connection to the terminals of a lead-acid battery.

BACKGROUND OF THE INVENTION

Battery cables, or booster cables, such as used in "jump starting" a vehicle, have been known in the art for some years. A set of booster cables typically includes a six-foot length of a two insulated electrical conductors of sufficient gauge to safely conduct starting current amperage. Four booster clamps, or battery clamps, resembling clothes pins and referred to as "crocodile clips," are provided at respective ends of the booster cable electrical conductor pair so as to electrically couple either two batteries, or one battery and a battery charger.

A conventional booster cable configures the battery clamps with serrated jaw ends to make mechanical and electrical contact with: (i) battery terminals or posts, if the battery is not installed in a vehicle, or (ii) vehicle battery cable terminals, if the battery is installed in a vehicle with the vehicle battery cable terminals secured onto the battery posts or terminals. The battery clamps are spring-loaded to force the clamp jaw serrations against the battery post or against the vehicle battery cable terminals, so as to provide a positive electrical connection to the respective battery post or to the vehicle battery cable terminal.

However, conventional battery clamps suffer from the shortcoming that the serrated ends of the battery clamps, typically made from copper or a copper alloy, cause indentations and other surface damage to the battery posts or vehicle cable terminals, which are typically made from lead—a softer metal than copper. Over time, the appearance and effectiveness of the battery posts or the vehicle cable terminals may suffer from repeated attachment of the booster cable.

Another shortcoming is that one of the battery clamps may be accidentally dropped into the vehicle chassis or engine compartment when a user is in the process of connecting or disconnecting the booster cable from a battery. If the vehicle is a negative-ground system, and it is the negative battery clamp that is dropped, a short circuit may result by conducting electrical current from the positive battery terminal into the chassis or engine components, and back into the battery, producing electrical arcing or sparking, and possibly igniting hydrogen gas being expelled from the charging battery.

A further shortcoming is that the connection of the booster cable to the battery typically requires using both hands to hold apart the booster clamps when securing the booster cable to the battery so as to not short out a battery connected to the other end of the booster cable. What is needed is a battery clamp configuration that overcomes the limitations of the prior art by providing a method to secure a booster cable to a battery without causing surface damage to lead-based components, while providing a good electrical contact, and which requires only one hand to attach or to remove the booster cable from a battery.

BRIEF SUMMARY OF THE INVENTION

In one aspect of the present invention, a compact battery clamp suitable for attachment to a high-amperage, two-conductor, insulated electrical cable, the compact battery clamp comprising: a clamp handle having a first clamp handle end and a second clamp handle end; a contact arm having a first contact arm end and a second contact arm end; a pivot pin passing through the clamp handle and through the first contact arm end so as to hingedly connect the contact arm to the clamp handle; a first terminal contact pad rotatably attached to the first clamp handle end; a second terminal contact pad rotatably attached to the second contact arm end; and an electrical socket attached to the second clamp handle end, the electrical socket configured for electrically coupling with an end of the insulated electrical cable.

In another aspect of the present invention, a booster cable suitable for use in charging a first battery with a second battery comprises: a two-conductor, insulated electrical cable; a first battery clamp electrically attached to a first end of the two-conductor, insulated electrical cable, the first battery clamp including a first contact arm hingedly connected to a first clamp handle, the first battery clamp generally configured in a lambda shape; and a second battery clamp electrically attached to a second end of the two-conductor, insulated electrical cable, the second battery clamp including a second contact arm hingedly connected to a second clamp handle, the second battery clamp generally configured in a lambda shape.

In still another aspect of the present invention, a method for electrically attaching a two-conductor electrical cable to battery posts, the method comprising the steps of: providing a first terminal contact pad; providing a second terminal contact pad; forcing the first terminal contact pad against a first battery terminal, and forcing the second terminal contact pad against a second battery terminal.

The additional features and advantage of the disclosed invention is set forth in the detailed description which follows, and will be apparent to those skilled in the art from the description or recognized by practicing the invention as described, together with the claims and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The uses and advantages of the present invention will be more fully appreciated as the same becomes better understood from the following detailed description of the present invention when viewed in conjunction with the accompanying figures, in which:

FIG. **1** is a diagrammatical illustration of a compact battery clamp in an open emplacement configuration, in accordance with an aspect of the present invention;

FIG. **2** is a diagrammatical illustration showing the compact battery clamp of FIG. **1**, with a clamp handle and a control arm, in a closed, functioning configuration;

FIG. **3**A is a detail view of a terminal contact pad used in the compact battery clamp of FIG. **1**;

FIG. **3**B is a detail view of the terminal contact pad of FIG. **3**A when positioned against a battery terminal;

FIG. **4** is a detail view of the terminal contact pad of FIG. **3** when positioned against a battery cable clamp;

FIG. **5** is a detail view of an alternative configuration of a terminal contact pad including wire mesh, for use in the compact battery clamp of FIG. **1**;

FIG. **6** is a detail view of the terminal contact pad of FIG. **5** when positioned against a battery cable clamp;

FIG. **7** is a detail view of the terminal contact pad of FIG. **5** when positioned against both a battery cable clamp and a battery terminal;

FIG. **8** is a diagrammatical top view of the compact battery clamp of FIG. **1**;

FIG. **9** is a longitudinal cross sectional view of the compact battery clamp of FIG. **8** showing first and second electrical conductors providing an electrical path between battery terminals and an electrical socket;

FIG. **10** is transverse cross-sectional view of the compact battery clamp of FIG. **8** showing first, second, and third electrical conductors providing an electrical path between battery terminals and the electrical socket of FIG. **9**;

FIG. **11** is a transverse cross-sectional view of an alternative configuration of a clamp handle for use with a tubular control arm;

FIG. **12** is a diagrammatical illustration of an exemplary embodiment of an electrical socket having horizontal polarized socket slots;

FIG. **13** is a diagrammatical illustration of another exemplary embodiment of an electrical socket having vertical polarized socket slots;

FIG. **14** is a diagrammatical illustration of still another exemplary embodiment of an electrical socket having circular socket openings;

FIG. **15** is a diagrammatical of yet another exemplary embodiment of an electrical socket having a coaxial opening configuration for mating with a coaxial plug on a pair of battery cable conductors;

FIG. **16** is a diagrammatical illustration of an alternative embodiment of a compact battery clamp with an adjustable two-component control arm, in accordance with an aspect of the present invention;

FIG. **17** is a detail illustration of the threaded connection for the two components of the control arm of FIG. **16**; and

FIG. **18** is an exemplary embodiment of a booster cable comprising two compact battery clamps of FIG. **1** electrically coupled to opposite ends of a high-amperage, two-conductor, insulated electrical cable, in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

There is shown in FIG. **1** a side view of a compact battery clamp **10**, in accordance with an aspect of the present invention. The compact battery clamp **10** comprises a clamp handle **12** with a contact arm **14**, hingedly secured to the clamp handle **12** by a pivot pin **16** in a first end of the contact arm **14**, the pivot pin **16** passing through both the clamp handle **12** and the contact arm **14**. In the configuration shown, first end of the contact arm **14** is connected at or near the mid-point of the clamp handle **12**, being thus enabled to swing through an arc of up to 180 degrees, limited only be contact with the clamp handle **12**. The clamp handle **12** may comprise primarily an electrically non-conducting or insulating material, such as a high-impact plastic or a composite material, with internally-disposed electrical conductors as shown below in FIG. **9**. As shown in the cross-sectional view of FIG. **10**, below, the clamp handle **12** comprises a U-shaped channel, to provide strength and rigidity, while allowing rotational movement of the contact arm **14** within the open region inside the clamp handle **12**.

When in use, a user may grasp the upper portion of the clamp handle **12**, and position the compact battery clamp **10** between the terminals **22** and **24** of a battery **20**, substantially as shown. The compact battery clamp **10** is configured so as to maintain electrical contact with both the terminals **22** and **24** after the clamp handle **12** has been moved downwardly, towards the battery **20**, as shown in FIG. **2**. When in the configuration of FIG. **2**, the compact battery clamp **10** functions as, and is a replacement for, a pair of conventional battery terminal clamps, or crocodile clips, as may be found in a typical set of a battery booster cable.

The clamp handle **12** may include a first terminal contact pad **32** rotatably attached to a first end of the clamp handle **12** by means of a first swivel connector **34**. The first swivel connector **34** provides the terminal contact pad **32** with at least two degrees of freedom with respect to the clamp handle **12**, so that the terminal contact pad **32** can be optimally swiveled and positioned against the battery terminal **24** to maximize the extent of a physical contact area. It should be understood that the contact pad may optimally position against the battery terminal **24** without requiring any adjustment from the user.

The contact arm **14** similarly includes a second terminal contact pad **36** rotatably attached to a second end of the contact arm **14** by means of a second swivel connector **38**. In an exemplary embodiment, the swivel connectors **34** and **38** may each comprise a ball and socket connector pair, as known in the relevant art. This swiveling feature optimizes the area of electrical contact of the compact battery clamp **10** with the battery terminals **22** and **24**, and results in a minimal voltage drop across the respective contact interfaces. It should be understood that the particular terminal contact pads **32** and **34** shown are merely exemplary of electrical connection devices that may be used at the first end of the clamp handle **12** and at the end of the contact arm **14**, and that any suitable electrical contact component may be used to perform the same functions as the terminal contact pads **32** and **34**.

Accordingly, when in an "open" position, shown in FIG. **1**, the compact battery clamp **10** can be placed into and positioned within the open space between the terminals **22** and **24**, here identified as the linear space denoted by the dimension "A." When in the open position, the clamp handle **12** and the contact arm **14** define a shape similar to the Greek letter "lambda," where the contact arm **14** corresponds to the shorter "leg" of the lambda shape.

When in a "closed" position, shown in FIG. **2**, the lambda shape of the compact battery clamp **10** may be reduced in height by moving apart the terminal contact pads **32** and **36**. This action serves to move the terminal contact pad **32** toward the battery terminal **24**, and the terminal contact pad **36** toward the battery terminal **22**. Thus, in the extended configuration shown in FIG. **2**, the terminal contact pad **36** has been forced against the battery terminal **22** and the terminal contact pad **32** has been forced against the battery terminal **24**.

In an exemplary embodiment, the compact battery clamp **10** can be configured so that an open space is defined between the battery **20** and the underside of the compact battery clamp **10**, here indicated as dimension "D." The empty space may be desired to provide clearance for a battery retaining strap, a bracket, or a battery vent cover disposed on the surface of the battery **20** after the compact battery clamp **10** has been placed into the extended configuration.

In an exemplary embodiment, the clamp handle **12** can be releasably secured in the closed position by means of a U-spring clamp **42**. By lowering the clamp handle **12** onto the contact arm **14**, as shown in FIG. **2**, the free ends of the U-spring clamp **42** engage both sides of the contact arm **14**. The lengths of the cantilever arms of the U-spring clamp **42**, here indicated as dimension "B," are preferably of sufficient length so as to partially enclose at least a portion of the contact

arm **14** when the compact battery clamp **10** makes contact with the battery terminals **22** and **24**.

Additionally, the selection of spring material used for the U-spring clamp **42** may produce a spring constant of sufficiently large value that the compressive force induced by the arms of the U-spring clamp **42** onto the sides of the contact arm **14** results in enough surface static friction to mitigate relative movement of the clamp handle **12** with respect to the contact arm **14**. In an alternative embodiment, the contact arm **14** may include a pair of dimple features (not shown) sized and positioned on the outer surface if the contact arm **14** so as to more positively engage and retain the free ends of the U-spring clamp **42**, as is well-known in the relevant art. In an alternative embodiment (not shown), the upper portion of the clamp handle **12** may be slightly curved away from the contact arm **14** so as to provide additional clearance between the upper portion of the clamp handle **12** and the battery **20** to more easily accommodate the hand of the user.

As explained above, the U-spring clamp **42** is configured to enclose and frictionally remain in position on the contact arm **14**, and thus functions to restrain the clamp handle **12** from moving off the contact arm **14**. The compact battery clamp **10** is, in this manner, maintained in a state of compression between the battery terminals **22** and **24** when the battery clamp **10** is emplaced for use as intended. As can be appreciated by one skilled in the art, this state of compression serves to increase the electrical conductivity at the interfaces between the battery terminals **22** and the terminal contact pads **32** and **36** of the compact battery clamp **10**. In an exemplary embodiment, the U-spring clamp **42** may be re-positioned along the clamp handle **12** by a sliding motion, to change the distance from the pivot pin **16** as desired, the distance here indicated as dimension "C." In an alternative embodiment, the

FIGS. **3**A and **3**B provide detail views of the top of the terminal contact pad **36** both before and after contact has been made with the battery terminal **22**. The terminal contact pad **36** may comprise a generally U-shaped electrically-conductive contact body **44**, such as a copper or aluminum alloy, and a flat flexible electrically-conductive terminal contact foil **46** attached to the legs of the terminal contact body **44**, so as to form a rectangular cylinder having open ends, substantially as shown. The configuration of the terminal contact pad **32** is substantially similar to that of the terminal contact pad **36**.

The thickness of the contact body **44** is preferably greater than the thickness of the terminal contact foil **46**. Alternatively, the rigidity of the contact body **44** is preferably greater than the rigidity of the terminal contact foil **46**. This configuration allows the terminal contact foil **46** to assume a generally curved shape, approximating the convex circumferential surface of the battery terminal **22**, when forced against the battery terminal **22**. This configuration also serves to return the terminal contact foil **46** to a generally planar shape when the terminal contact pad **36** is moved away from the battery terminal **22**, as shown in FIG. **3**B. When the terminal contact pad **36** is forced against the battery terminal **22**, shown in FIG. **3**B, it can be seen that the contact body **44** generally retains its shape because of the greater rigidity and wall thickness of the contact body **44**.

It can thus be appreciated that the legs of the terminal contact body **44** are slightly bent inwardly when the terminal contact pad **36** is forced against the battery terminal **22**, and spring back when the terminal contact pad **36** is removed from the battery terminal **22**. By enabling the terminal contact foil **46** to partially wrap about the battery terminal **22**, when the compact battery clamp **10** is placed into a state of tension, a greater contact area is achieved with the battery terminal **22**, than if the terminal contact foil **46** remained flat, or if the terminal contact pad **36** were fabricated as a single, rigid component.

This configuration also allows for use of the compact battery clamp **10** when a vehicle battery cable clamp **48** is attached to either or both the battery terminals **22** and **24**, such as may be the case when the battery **20** is mounted in a vehicle engine compartment. It can be appreciated by one skilled in the relevant art that the vehicle battery cable clamp **48** has a larger diameter than the battery terminal **22** and, because of flexibility of the terminal contact foil **46**, the terminal contact foil **46** can partially wrap around both the battery cable clamp **48** and the battery terminal **22** so as to increase the area of physical and electrical contact. The compact battery clamp **10** can thus be used in the process of charging the battery **20** (*i*) when the battery **20** has been removed from a vehicle and placed on a bench, or (ii) when the battery **20** remains secured in an engine compartment and is electrically connected to a pair of vehicle battery cable clamps **48**.

In an alternative exemplary embodiment, a terminal contact pad **50**, shown in FIG. **5**, may be used on the end of the end of the contact arm **14**, in place of the terminal contact pad **36**. Likewise, the terminal contact pad **50** may be used on the end of the clamp handle **12**, in place of the terminal contact pad **32**. The terminal contact pad **50** comprises one or more layers of a wire mesh **54** attached to the inside a terminal contact cup **52**. The wire mesh **54** preferably comprises a corrosion-resistant metal or metal alloy, such as stainless steel.

The terminal contact cup **52** is sized and shaped so as to generally conform to: (i) the outer surface contour of the battery terminal **20**, as shown in FIG. **5**, as well as (ii) to the outer surface contour of the battery cable clamp **48**, as shown in FIG. **6**. That is, the terminal contact cup **52** presents a cylindrical concave surface to the battery terminal **20**. The configuration shown serves to increase the surface area of electrical contact between the terminal contact pad **50** and the battery terminal **22**, for example, than if no wire mesh **54** were provided on the terminal contact cup **52**.

As can be appreciated, the contact cup **52** may be too inflexible to usefully conform to the outer contour of the battery terminal **22** or to the outer contour of the battery cable clamp **48**. Consequently, electrical resistance is thereby reduced between the terminal contact pad **50** and the battery terminal **22**, and between the terminal contact pad **50** and the battery cable clamp **48**. In addition, the terminal contact cup **52** may be mounted to the swivel connector **38** for the reasons stated above.

As shown in FIG. **7**, the terminal contact pad **50** can be rotated ninety degrees, more or less, about the longitudinal axis of the contact arm **14** and positioned so as to physically and electrically contact both the battery cable clamp **48** and the battery terminal **22**. It can be appreciated by one skilled in the art that, when the compact battery clamp **10** is placed in a compression state between the battery terminals **22** and **24**, or between battery cable clamps **48**, the wire mesh **54** is selectively compressed to generally conform to and substantially fill the space between the terminal contact cup **52** and the battery terminal **22**, as in FIG. **5**, or between the terminal contact cup **52** and the battery cable clamp **48**, as in FIG. **6**, or between the terminal contact cup **52** and both the battery terminal and the battery cable clamp **48**, as in FIG. **7**. As stated above, this compressible feature of the wire mesh **54** serves to increase the surface contact area between the respective components, and thus increases the electrical conductance between the respective components.

FIG. **8** provides a top view of the compact battery clamp **10** of FIG. **1**. As can be seen in FIG. **8** and in the cross-sectional view of FIG. **9**, an electrical socket **60** is provided at a second end of the U-shaped channel clamp handle **12**. In an exemplary embodiment, the electrical socket **60** comprises a first electrical connector **72** and a second electrical connector **74**. The electrical socket **60** allows for a pair of insulated electrical cables **28**, shown in FIG. **18** below, to be plugged into the compact battery clamp **10** for use in "jumping" a lead-acid battery, for example, as is well-known in the relevant art. Preferably, the electrical connectors **72** and **74** form a polarized set so as to permit only one connection orientation when attaching the electrical cables **28** to the compact battery clamp **10**.

As the electrical cables **28** can be attached or removed as desired, the combination of two compact battery clamps **10** and the pair of electrical cables **28** provide for a booster cable assembly **150**, shown in FIG. **18**, that is more compact, and less likely to tangle, than a conventional set of battery jumper cables or booster wires that use crocodile clip battery terminal attachment means.

As best seen in FIG. **9** and in the cross-sectional view of FIG. **10**, a first electrical conductor **62** is provided between the electrical connector **74** and the pivot pin **16**. Similarly, as seen in FIG. **8**, a second electrical conductor **64** is provided between the electrical connector **74** and the pivot pin **16**. The electrical conductors **62** and **64** may each comprise a thick, but narrow, bar of electrically-conductive material, such as copper or aluminum. The electrical conductors **62** and **64** are of sufficient cross sectional area, and have sufficient conductance, so as to permit the flow of electrical current sufficient to charge the battery **20**, for example.

As also seen in FIGS. **9** and **10**, a third electrical conductor **66** is provided between the electrical connector **72** and the swivel connector **34**. The third electrical conductor **66** may similarly comprise a thick, but narrow, bar of electrically-conductive material, such as copper or aluminum, having a sufficient cross sectional area and conductance so as to permit the return flow of electrical current for charging purposes.

It can thus be appreciated by one skilled in the art that a first electrical path runs from the electrical connector **72**, through the third electrical conductor **66**, through the swivel connector **34**, through the terminal contact pad **32**, and to the battery terminal **24**. A second electrical path runs from the electrical connector **74**, through both the first electrical conductor **62** and the second electrical conductor **64**, through the pivot pin **16**, through the contact arm **14**, through the swivel connector **38**, through the terminal contact pad **36**, and to the battery terminal **22**. In an exemplary embodiment, an insulating layer **70** may be provided on the surface of the clamp handle **12** to reduce the risk of electrical shorts during emplacement and positioning of the compact battery clamp **10** between the battery terminals **22** and **24**, and near protruding metal components, such as may be found in the engine compartment of a motorized vehicle.

As also shown in the cross-sectional view of FIG. **10**, the U-spring clamp **42** comprises a first flexible clamp leg **76** and a second flexible clamp leg **78**. When the clamp handle **12** is pushed towards the contact arm **14**, as indicated by arrow **68**, the flexible clamp legs **76** and **78** bear against the sides of the contact arm **14** to prevent movement of the clamp handle **12** away from the contact arm **14**, as explained above in greater detail. In an alternative exemplary embodiment, shown in FIG. **11**, the channel-shaped contact arm **14** may be replaced by a tubular contact arm **88**.

Accordingly, in the alternative embodiment, the combination of the clamp handle **12** and the U-spring clamp **42** may be replaced by a clamp handle **80** comprising interior concave recesses **82** and **84**, as shown, for retention of the tubular contact arm **88**. When the clamp handle **80** is pushed towards the tubular control arm **88**, the tubular control arm **88** may enter the clamp handle **80** and engage both the recesses **82** and **84**. This can function to place the corresponding clamp handle **12** into a state of compression between battery terminals or vehicle battery cable clamps, as explained in greater detail above.

It should be understood that the configuration of the mating socket openings in the electrical socket **60** is not limited to any one particular geometric shape. As shown in FIG. **12**, an electrical socket **100** may be emplaced on the end of the clamp handle **12**. The electrical socket **100** includes a first slot opening **102**, and a second, smaller slot opening **104**, where the slot openings **102** and **104** form a polarized pair of parallel slots having longer widths than heights. Accordingly, the electrical cable **28** would include spade-like plugs (not shown for clarity of illustration) to mate with the slot openings **102** and **104**. In an exemplary alternative embodiment, shown in FIG. **13**, an electrical socket **110** includes a first slot opening **112**, and a second, smaller slot opening **114**, where the slot openings **112** and **114** form a polarized pair of parallel slots having larger heights than widths. Alternatively, the electrical socket **60** may include two slots (not shown) oriented as ninety degrees to one another rather than having a parallel orientation.

In an exemplary alternative embodiment, shown in FIG. **14**, an electrical socket **120** includes a first circular opening **122**, and a second circular opening **124**, where the diameter of the first circular opening **122** is different from the diameter of the second circular opening **124**. Accordingly, the electrical cable **28** would include cylindrical termination plugs (not shown for clarity of illustration) to mate with the circular openings **122** and **124**.

In yet another exemplary alternative embodiment, shown in FIG. **15**, an electrical socket **130** includes a coaxial-type configuration, in which a center electrical contact pin **132** is positioned inside a generally cylindrical conductive layer **134**. Accordingly, the electrical cable **28** would include a coaxial-type plug (not shown for clarity of illustration) at each end of the electrical cable, to mate with the coaxial-type socket **130**. It can be appreciated that, no matter which configuration of electrical socket is used with the clamp handle **12**, the electrical cable **28** will include appropriate mating plugs, where the mating plugs can be electrically connected to the electrical socket **100**, to the electrical socket **110**, to the electrical socket **120**, or to the electrical socket **130**, as is well-known in the relevant art.

In an exemplary embodiment, shown in FIG. **16** and the detail view of FIG. **17**, a compact battery clamp **140** comprised the clamp handle **12** and a cylindrical contact arm **142**. The length of the contact arm **142** may be adjusted by rotating a lower tubular member **144** with respect to an upper cylindrical member **146**, as indicated by arrow "F." This adjustment feature allows a single compact battery clamp **140** to be used on different batteries, having different terminal-to-terminal dimensions, denoted as dimension "A" in FIG. **1**, as described above.

The adjustment feature may include an internal thread **148** formed in the lower tubular member **144**, and an external thread **149** formed on the upper cylindrical member **146**, for example. That is, the lower tubular member **144** thus has a threaded interface with the upper cylindrical member **146**. The upper cylindrical member **146** may comprise a solid rod, or a hollow tube, as may be specified by a product designer. Alternatively, a chuck-like configuration (not shown) can be

included on the upper end of the lower tubular member **144**, to enable a sliding adjustment of the upper cylindrical member **146** into and out of the lower tubular member **144**.

There is shown in FIG. **18** an exemplary embodiment of the booster cable **150** as may be used in charging a discharged battery **26** with a charged battery **20**. As described above, the innovative booster cable **150** includes the high-amperage, two-conductor, insulated electrical cable **28**, or insulated cable pair, with the electrical socket **60** of a first compact battery clamp **10** electrically coupled to a first end of the electrical cable **28**, and the electrical socket **60** of a second compact battery clamp **10** electrically coupled to a second end of the electrical cable **28**. Preferably, there is provided a first electrical path: (i) from the first terminal contact pad **32** on the clamp handle **12** in the first compact battery clamp **10**, (ii) through one of the conductors in the high-amperage, two-conductor, insulated electrical cable **28** and (iii) to the first terminal contact pad **32** on the clamp handle **12** in the second compact battery clamp **10**. Similarly, there is provided a second electrical path: (i) from the second terminal contact pad **36** on the control arm **14** in the first compact battery clamp **10**, (ii) through the other one of the conductors in the high-amperage, two-conductor, insulated electrical cable **28** and (iii) to the second terminal contact pad **36** on the control arm **14** in the second compact battery clamp **10**.

For clarity of illustration, the booster cable **150** is shown attached to the battery posts of the batteries **20** and **26**, but it should be understood that the compact battery clamps **10** may be used as well when vehicle battery cable terminals remain emplaced on the battery posts of one or both batteries **20**, **26**. In an alternative embodiment, one or two compact battery clamps **140** (not shown) may be used in place of one or both the compact battery clamps **10**, at respective ends of the high-amperage, two-conductor, insulated electrical cable **28**, in accordance with the present invention.

It is to be understood that the description herein is only exemplary of the invention, and is intended to provide an overview for the understanding of the nature and character of the disclosed booster cable and battery clamp configurations. The accompanying drawings are included to provide a further understanding of various features and embodiments of the method and devices of the invention which, together with their description and claims serve to explain the principles and operation of the invention.

What is claimed is:

1. A compact battery clamp suitable for attachment to a high-amperage, two-conductor, insulated electrical cable, said compact battery clamp comprising:

a clamp handle having a first clamp handle end and a second clamp handle end;

a contact arm having a first contact arm end and a second contact arm end;

a pivot pin passing through said clamp handle and through said first contact arm end so as to hingedly connect said contact arm to said clamp handle;

a first terminal contact pad rotatably attached to said first clamp handle end;

a second terminal contact pad rotatably attached to said second contact arm end; and

an electrical socket attached to said second clamp handle end, said electrical socket configured for electrically coupling with an end of the insulated electrical cable.

2. The compact battery clamp of claim **1** wherein said pivot pin passes through a mid-point of said clamp handle.

3. The compact battery clamp of claim **1** wherein said first contact arm end is connected proximate a mid-point of said clamp handle.

4. The compact battery clamp of claim **1** further comprising a first swivel connector for attaching said first terminal contact pad to said first clamp handle end, and a second swivel connector for attaching said second terminal contact pad to said second contact arm end.

5. The compact battery clamp of claim **4** wherein said first swivel connector comprises a ball and socket connector pair.

6. The compact battery clamp of claim **1** further comprising a U-spring clamp attached to said clamp handle, said U-spring clamp positioned so as to releasably engage said contact arm.

7. The compact battery clamp of claim **1** further comprising an interior concave recess disposed inside said clamp handle, said interior concave recess positioned so as to releasably engage said contact arm.

8. The compact battery clamp of claim **1** wherein said clamp handle comprises an electrically non-conductive material.

9. The compact battery clamp of claim **1** wherein said contact arm comprises an electrically conductive material.

10. The compact battery clamp of claim **1** further comprising a first electrical conductor providing a first electrically conductive path between said electrical socket and said pivot pin and a second electrical conductor providing a second electrically conductive path between said electrical socket and said pivot pin.

11. The compact battery clamp of claim **1** further comprising a third electrical conductor providing a third electrically conductive path between said electrical socket and said first terminal contact pad.

12. The compact battery clamp of claim **1** wherein said first terminal contact pad comprises a terminal contact foil disposed on a U-shaped electrically conductive body.

13. The compact battery clamp of claim **1** wherein said first terminal contact pad comprises a wire mesh disposed within a terminal contact cup.

14. The compact battery clamp of claim **1** wherein said contact arm comprises a lower tubular member connected to an upper cylindrical member, said lower tubular member having a threaded interface with said upper cylindrical member.

15. A booster cable suitable for use in charging a first battery with a second battery, said booster cable comprising:

a two-conductor, insulated electrical cable;

a first battery clamp electrically attached to a first end of said two-conductor, insulated electrical cable, said first battery clamp including a contact arm hingedly connected to a clamp handle by a pivot pin, said first battery clamp further having a terminal contact pad connected to said contact arm; and

a second battery clamp electrically attached to a second end of said two-conductor, insulated electrical cable.

16. The booster cable of claim **15** wherein said booster cable is configured to provide an electrical path, from said terminal contact pad, through a conductor in said two-conductor, insulated electrical cable, and to said second battery clamp.

17. A method of electrically attaching a two-conductor electrical cable to battery posts and terminals, said method comprising the steps of:

providing a first terminal contact pad, said first terminal contact pad connected to a clamp handle, said clamp handle having a contact arm hingedly secured to said clamp handle by a pivot pin;

providing a second terminal contact pad, said second terminal contact pad connected to said contact arm;

positioning said first terminal contact pad against a first battery terminal, and,

pushing said clamp handle towards said contact arm to force said first terminal contact pad against said first battery terminal and force said second terminal contact pad against a second battery terminal.

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